US009325111B2

(12) **United States Patent**
Pierik et al.

(10) **Patent No.: US 9,325,111 B2**
(45) **Date of Patent: Apr. 26, 2016**

(54) **ELECTRICAL CENTER AND CONNECTOR ASSEMBLY SYSTEM**

(71) Applicant: **Lear Corporation**, Southfield, MI (US)

(72) Inventors: **Bruce H. Pierik**, Hazel Park, MI (US); **Jonathan Dahlstrom**, Highland, MI (US); **Steven F. Gawron**, Plymouth, MI (US)

(73) Assignee: **Lear Corporation**, Southfield, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 60 days.

(21) Appl. No.: **14/087,795**

(22) Filed: **Nov. 22, 2013**

(65) **Prior Publication Data**

US 2014/0154898 A1 Jun. 5, 2014

Related U.S. Application Data

(60) Provisional application No. 61/731,544, filed on Nov. 30, 2012.

(51) **Int. Cl.**
H01R 13/629 (2006.01)

(52) **U.S. Cl.**
CPC ***H01R 13/62966*** (2013.01)

(58) **Field of Classification Search**
CPC H01R 13/62938; H01R 13/62966
USPC 439/76.2
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,430,011	A	11/1947	Gillentine	
5,788,529	A *	8/1998	Borzi et al.	439/364
5,873,745	A *	2/1999	Duclos et al.	439/157
6,254,414	B1	7/2001	Sawayanagi et al.	
7,066,763	B1 *	6/2006	Corwin et al.	439/372
7,094,081	B1	8/2006	Senk et al.	
7,241,154	B1	7/2007	Mauney et al.	
7,670,159	B2 *	3/2010	Shamoto et al.	439/157
8,047,860	B2 *	11/2011	Gladd et al.	439/152
2010/0038133	A1 *	2/2010	Senk et al.	174/72 B

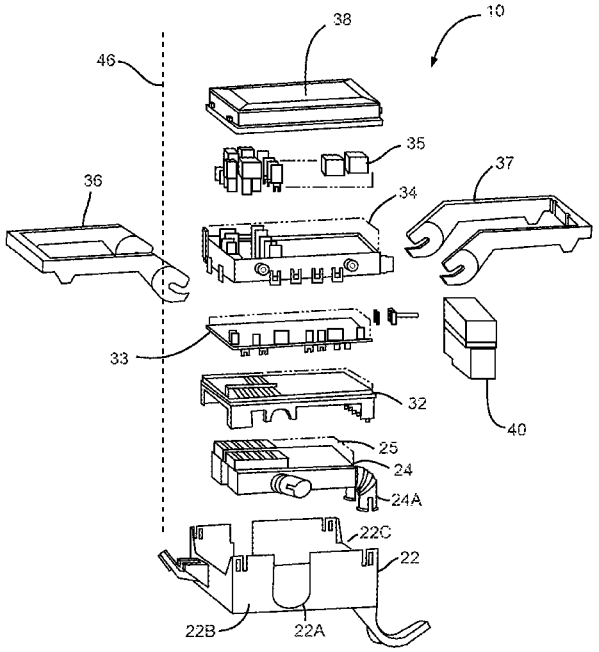
* cited by examiner

Primary Examiner — Amy Cohen Johnson
Assistant Examiner — Matthew T Dzierzynski
(74) *Attorney, Agent, or Firm* — MacMillan, Sobanski & Todd, LLC

(57) **ABSTRACT**

An electrical junction box has a connector retainer assembly with a first contact surface, as well as a connector housing assembly with a pivotal lever arm. The lever arm has a first engagement surface. The connector retainer assembly and the connector housing assembly configured so that when the lever arm is moved in a single direction relative to the connector housing assembly, the first engagement surface engages the first contact surface and the connector housing assembly moves relative to the connector retainer assembly from a pre-staged position to an assembled position.

11 Claims, 16 Drawing Sheets



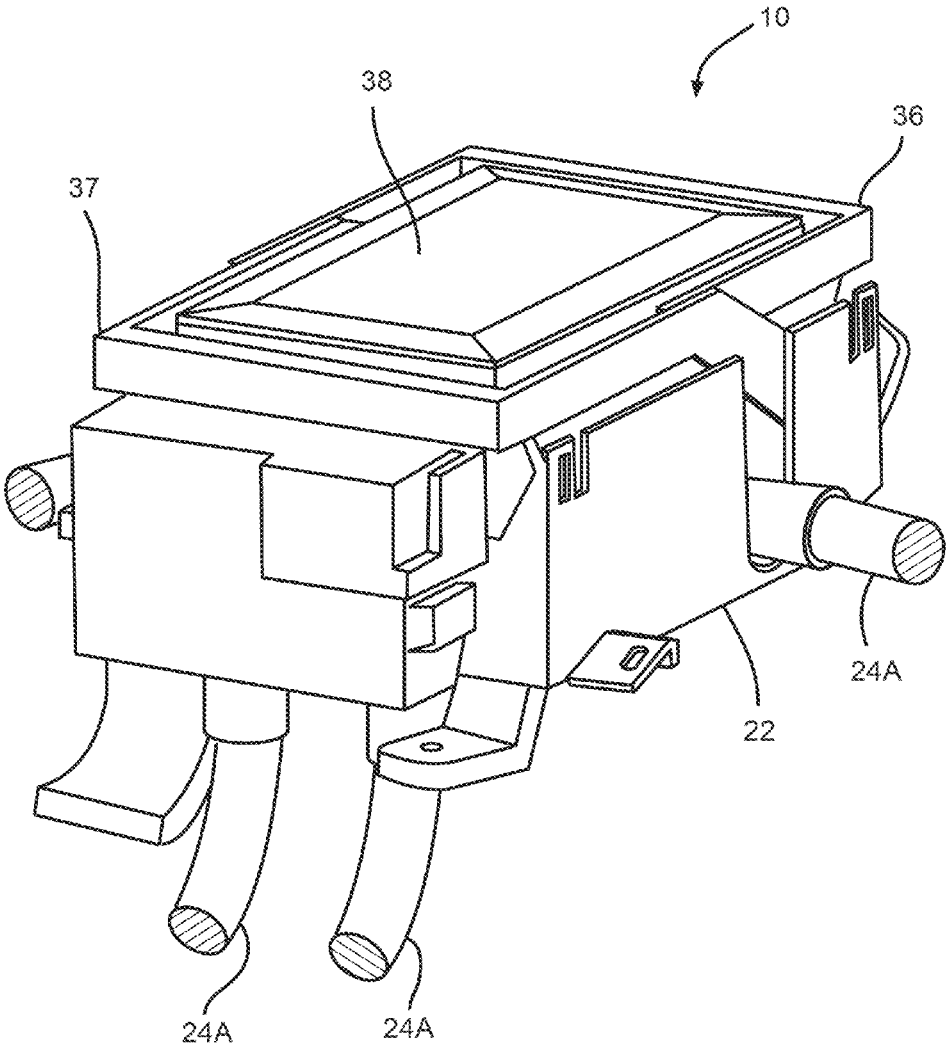


FIG. 1

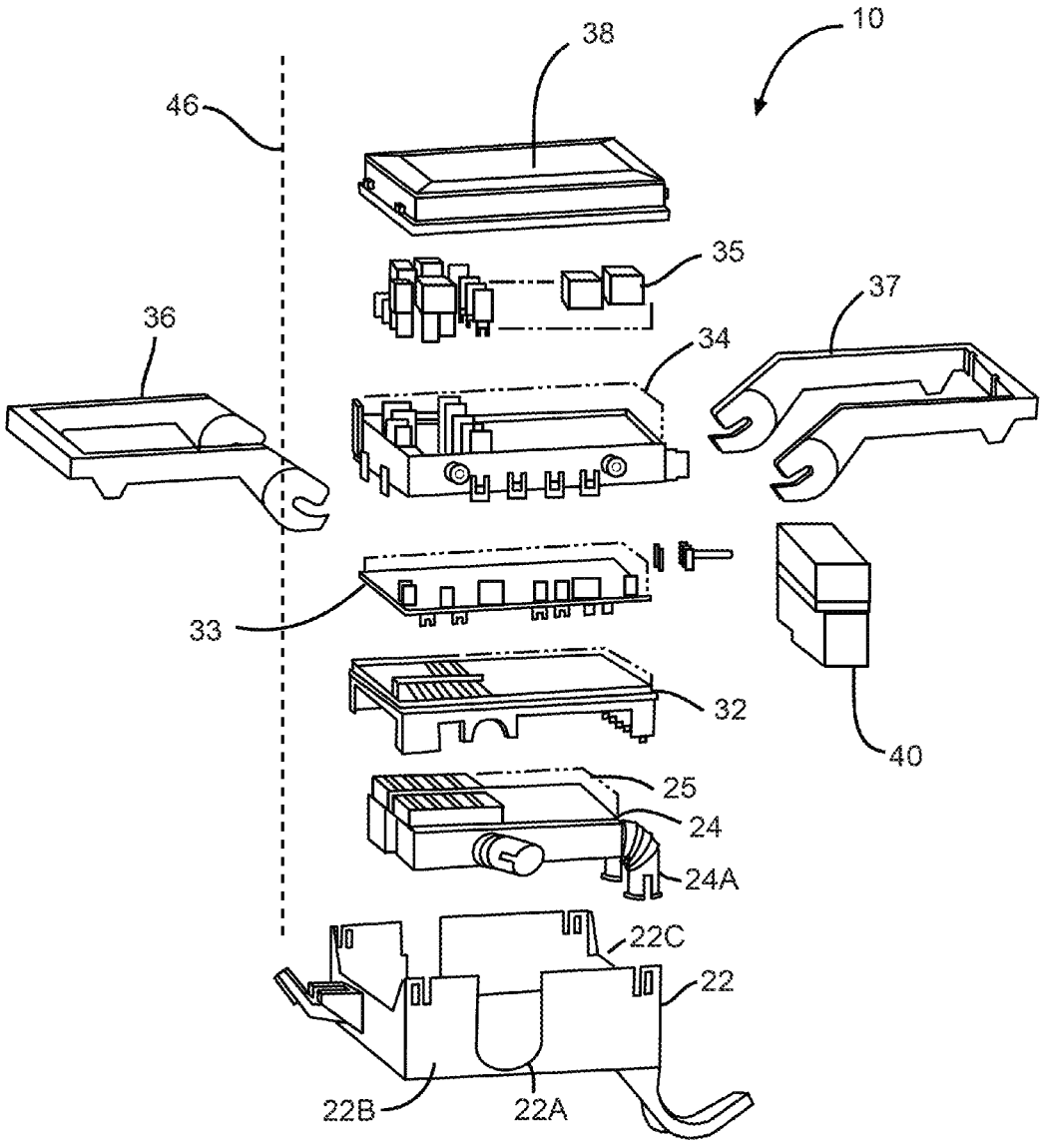


FIG. 2

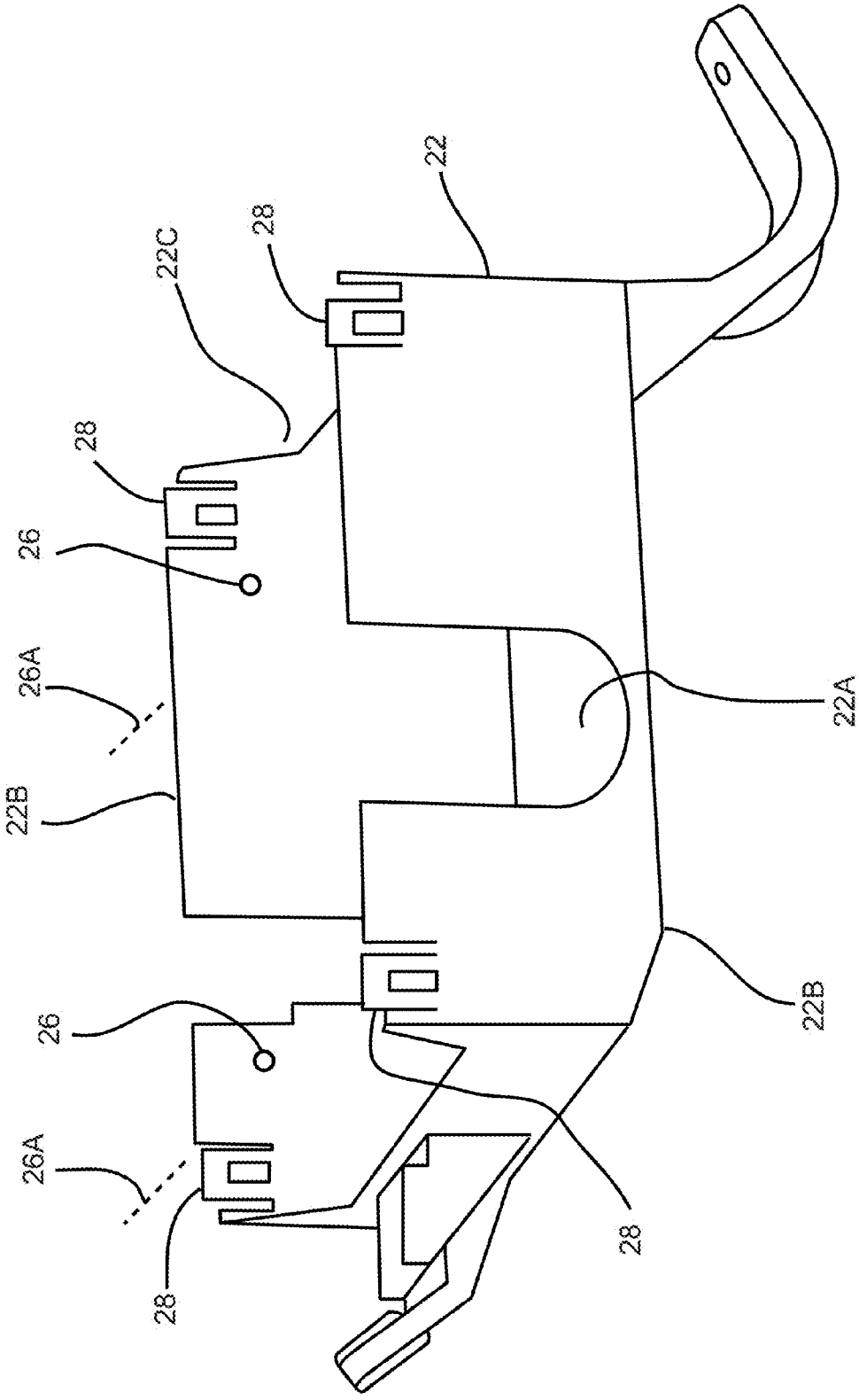


FIG. 3

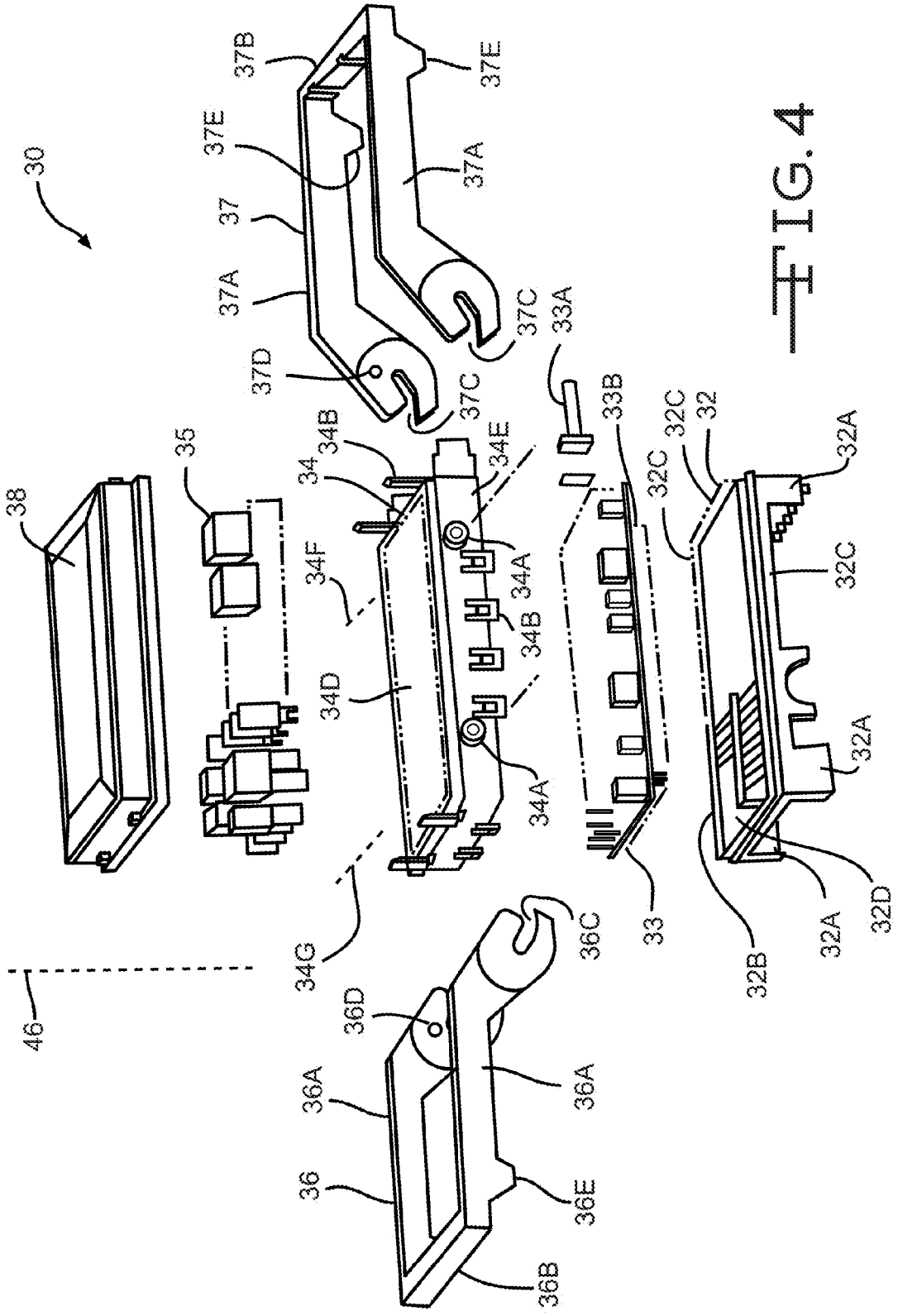

30
37B
37E
37E
37A
37
37A
37D
37C
37C
33A
33B
32C
32
32A
32C
32C
32A
32A
32D
32B
33
38
35
34
34B
34E
34F
34A
34B
34D
34A
34G
36C
36D
36A
36A
36
36E
36B
46

FIG. 4

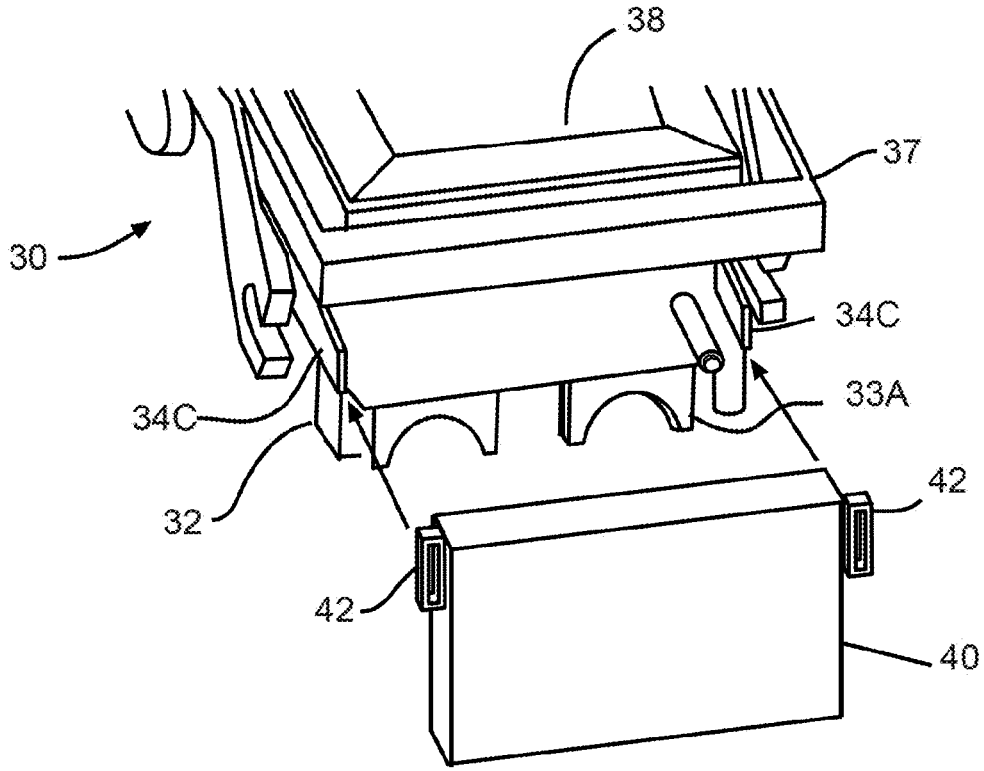


FIG. 5

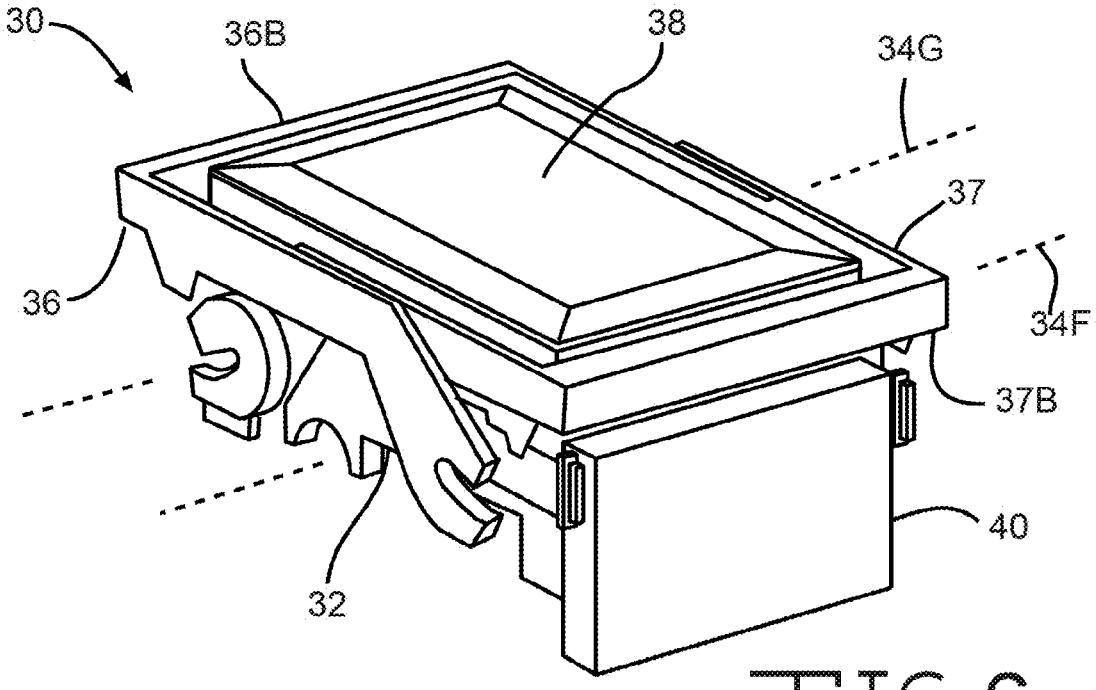


FIG. 6

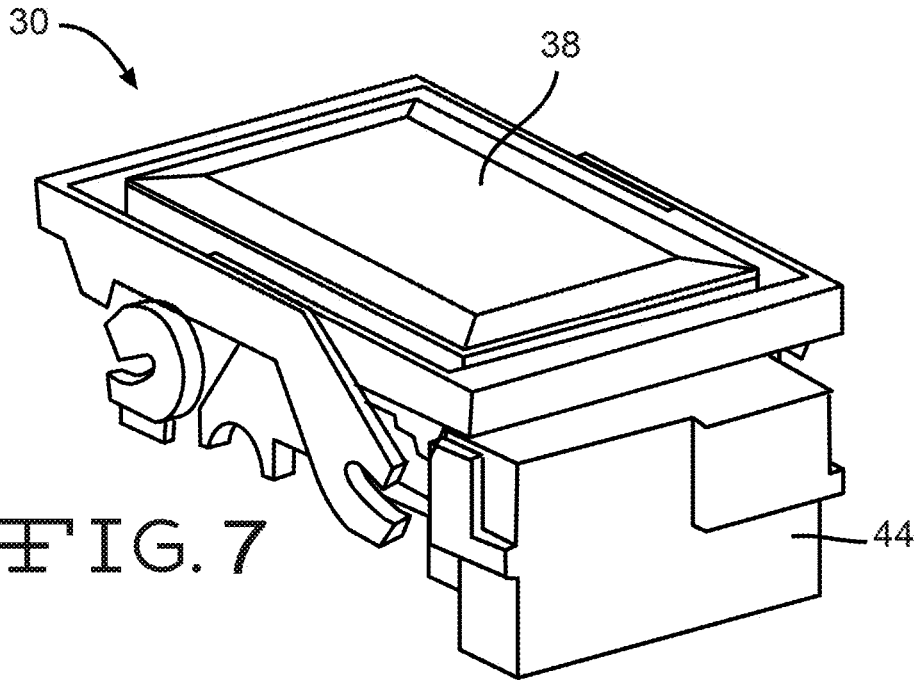


FIG. 7

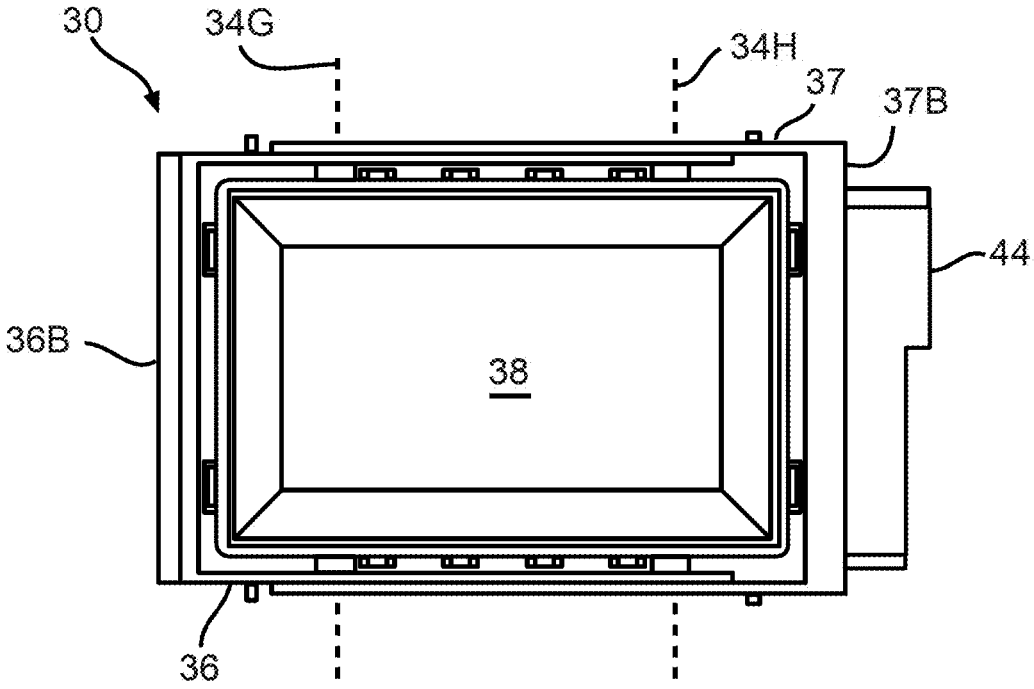


FIG. 8

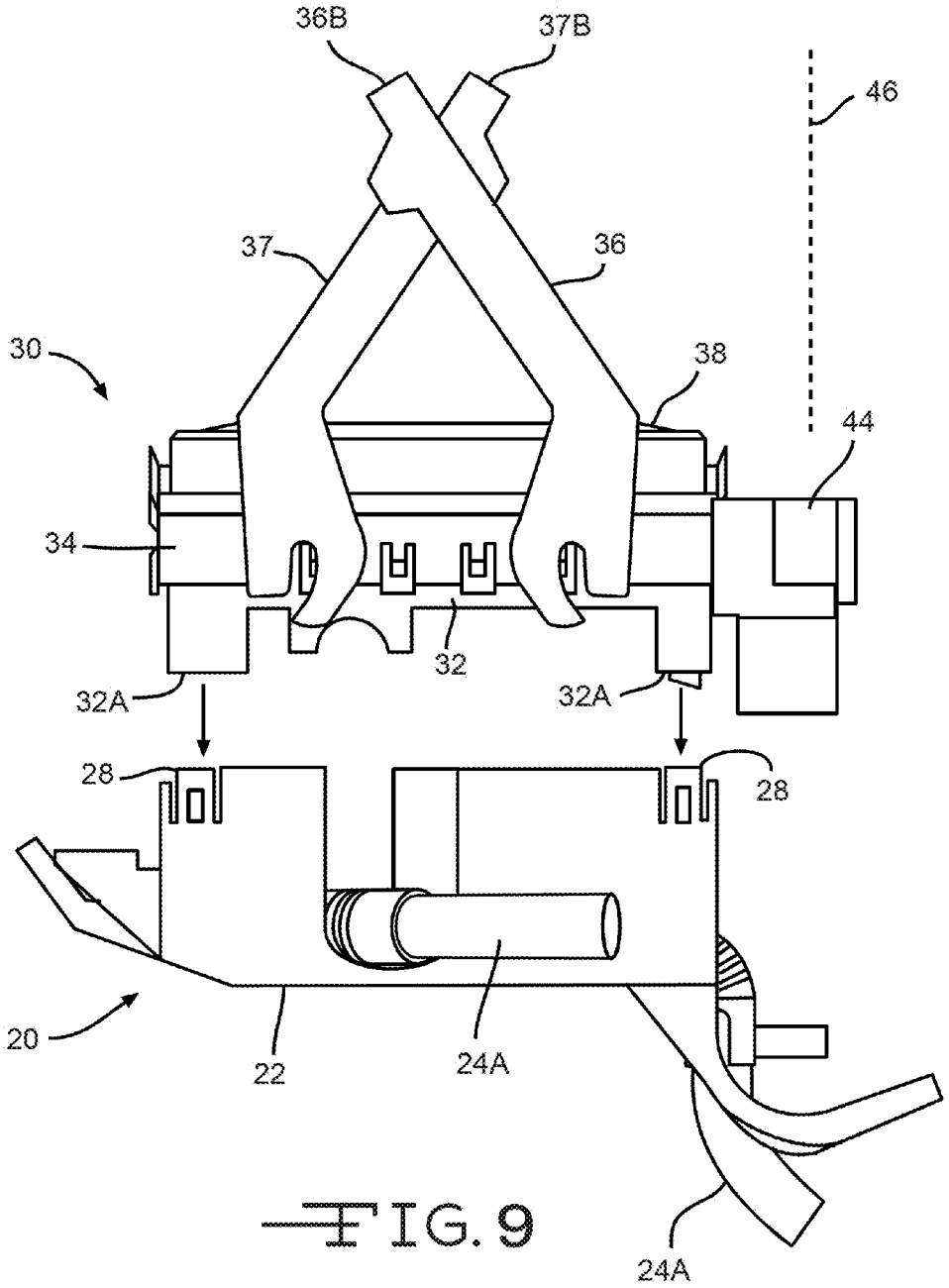


FIG. 9

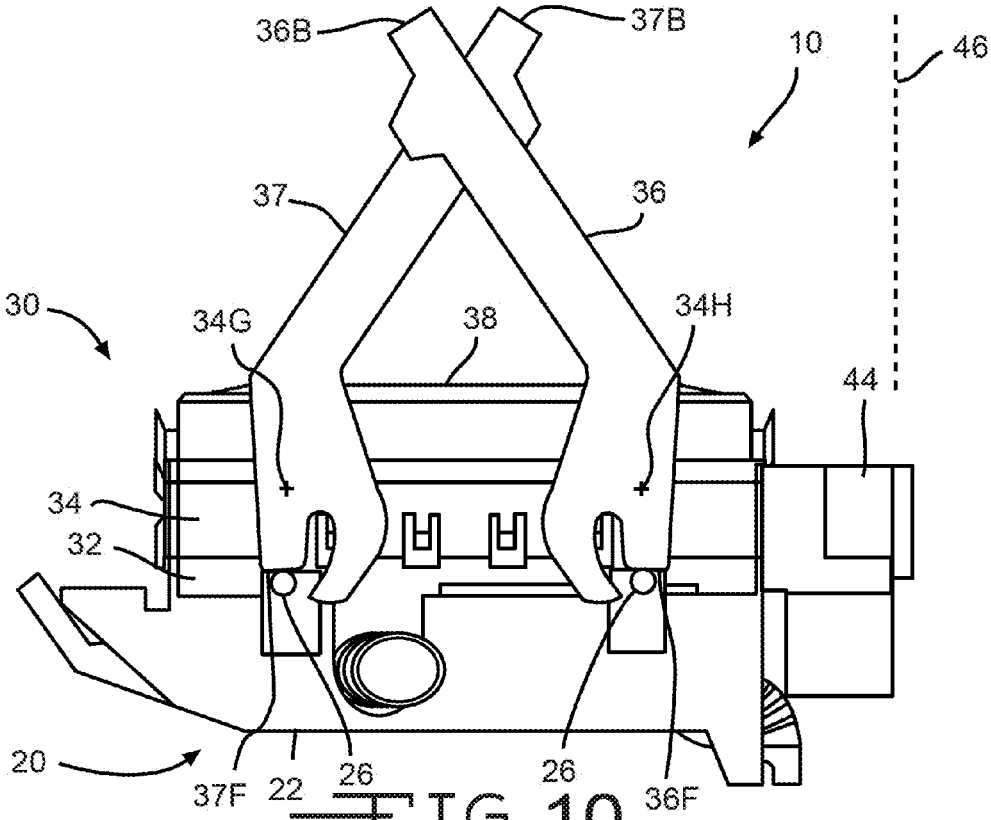

36B
37B
10
46
37
36
30
34G
38
34H
44
34
32
20
37F
22
26
26
36F

FIG. 10

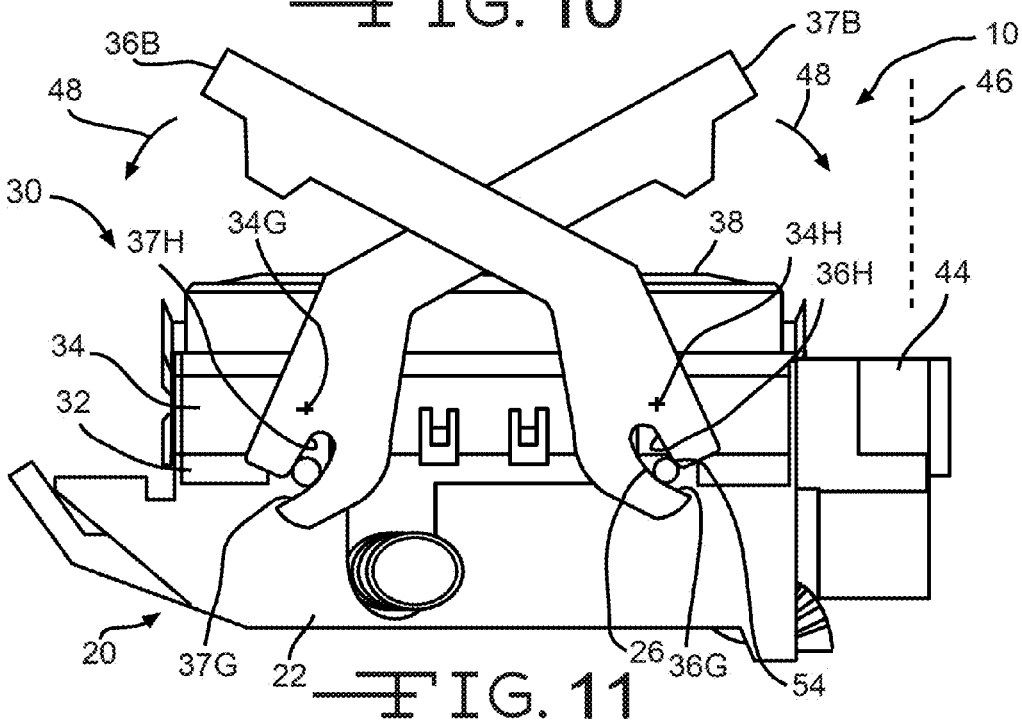

36B
37B
10
48
48
46
30
37H
34G
38
34H
36H
44
34
32
20
37G
22
26
36G
54

FIG. 11

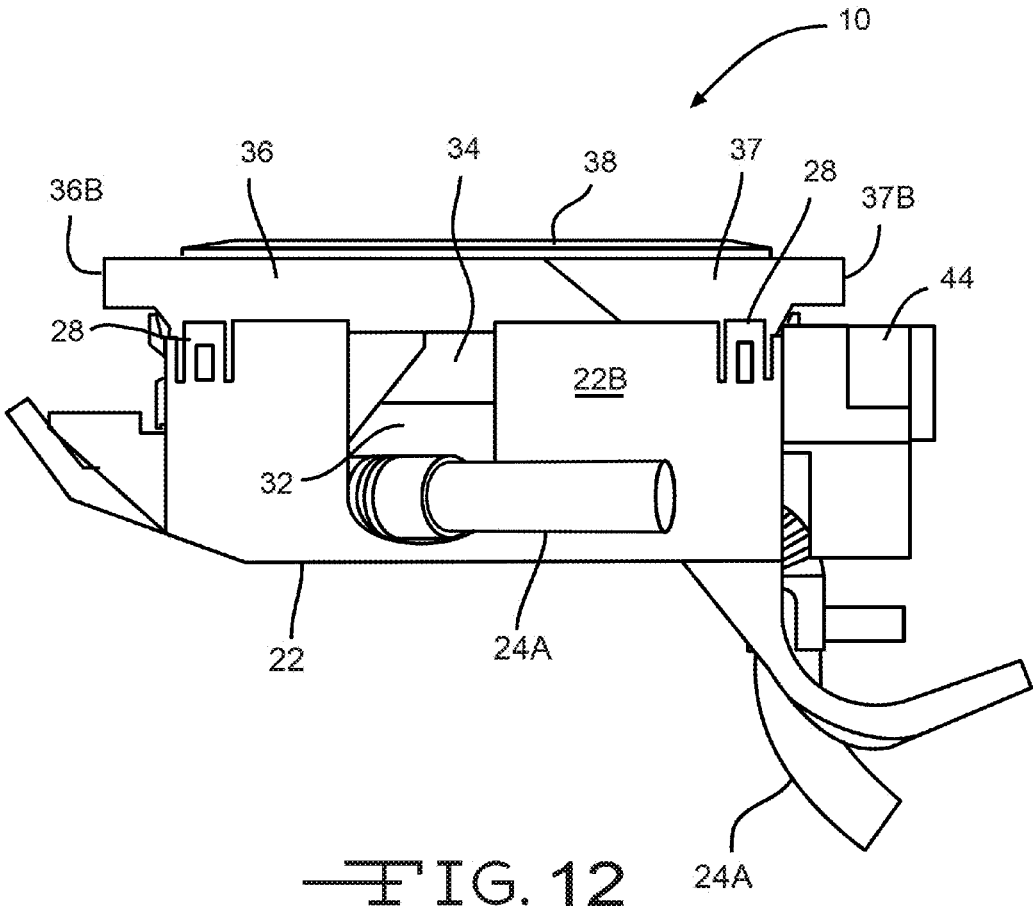


FIG. 12

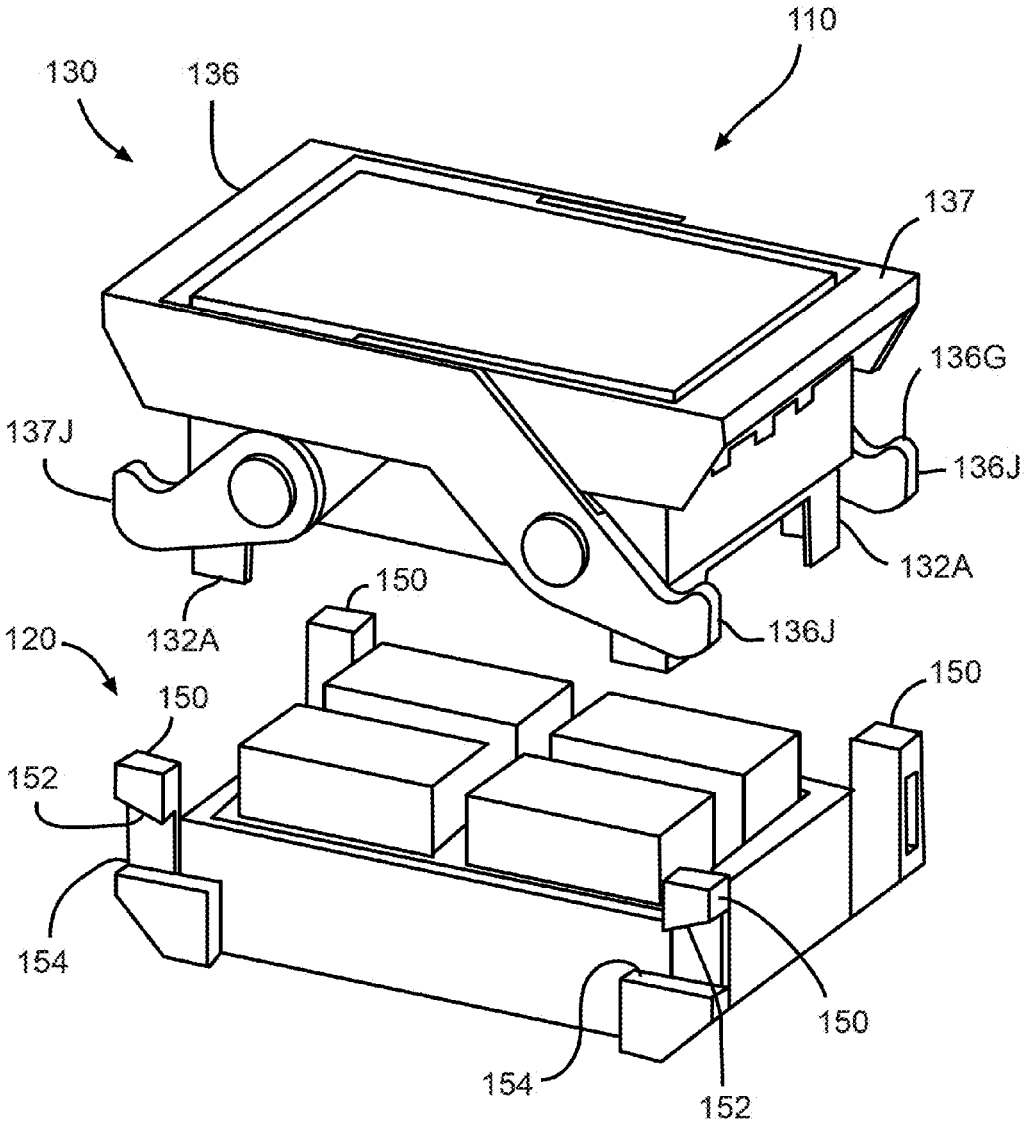

110
130
136
137
136G
137J
136J
132A
150
120
132A
136J
150
150
152
154
150
154
152

FIG. 13

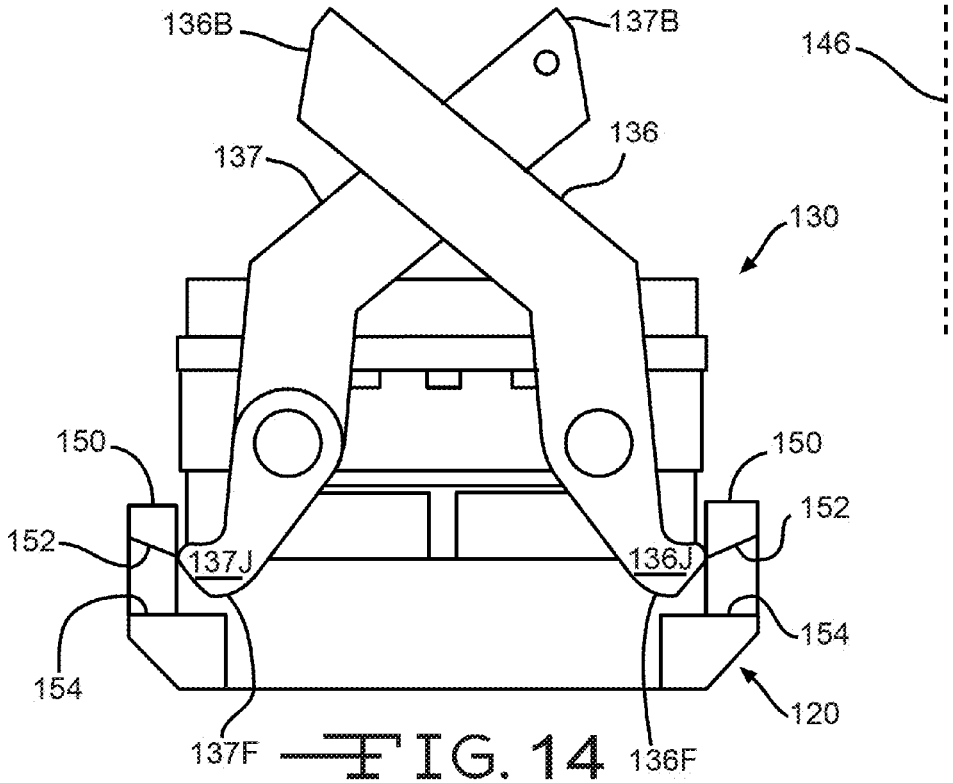

136B
137B
146
136
137
130
150
150
152
152
137J
136J
154
154
120
137F
136F

FIG. 14

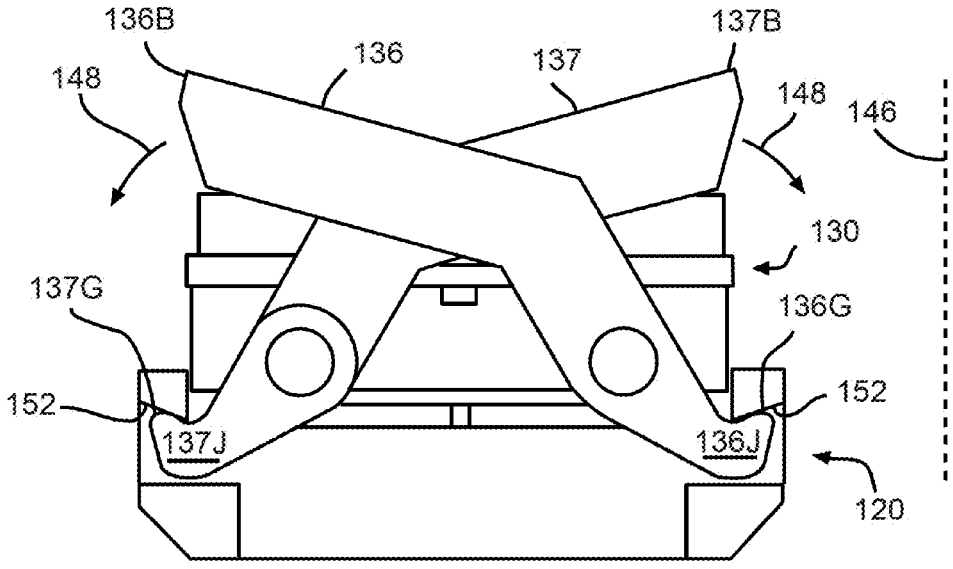

136B
136
137
137B
148
148
146
130
137G
136G
152
152
137J
136J
120

FIG. 15

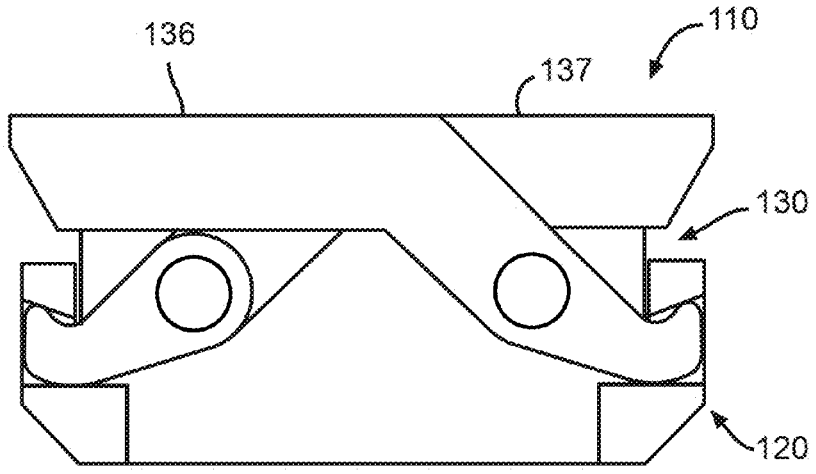

136
137
110
130
120

FIG. 16

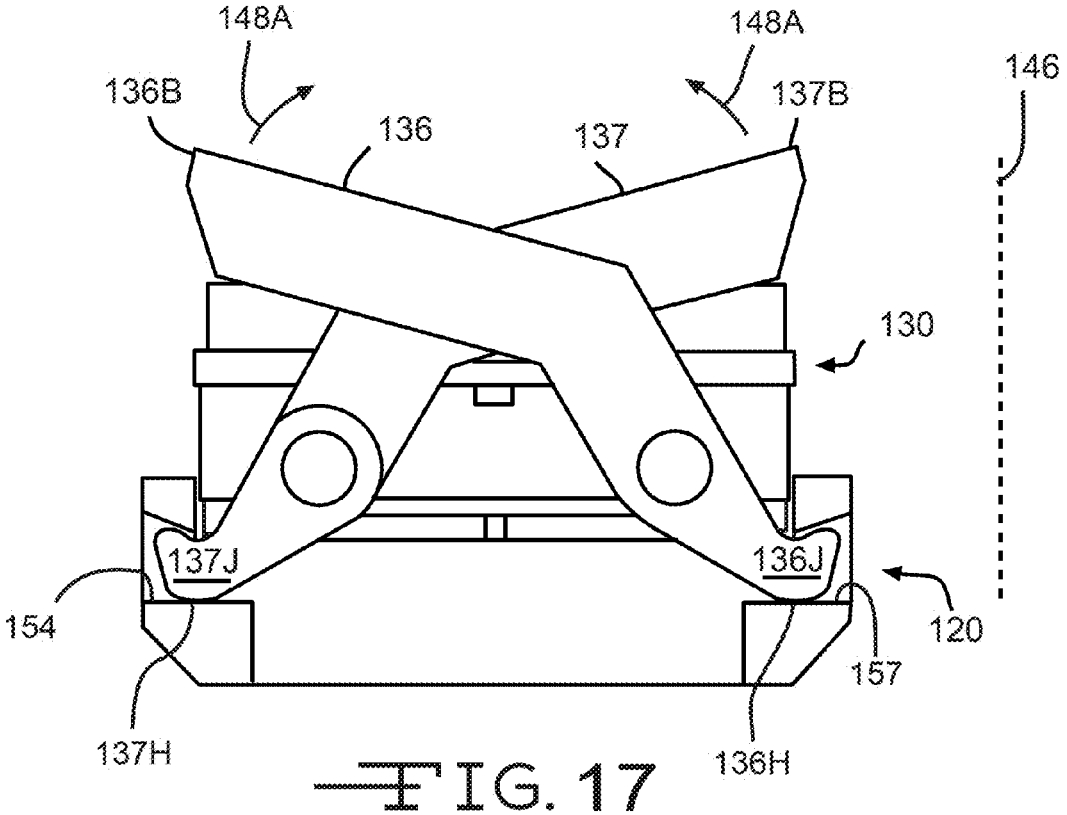

148A
148A
136B
136
137
137B
146
130
137J
136J
154
120
157
137H
136H

FIG. 17

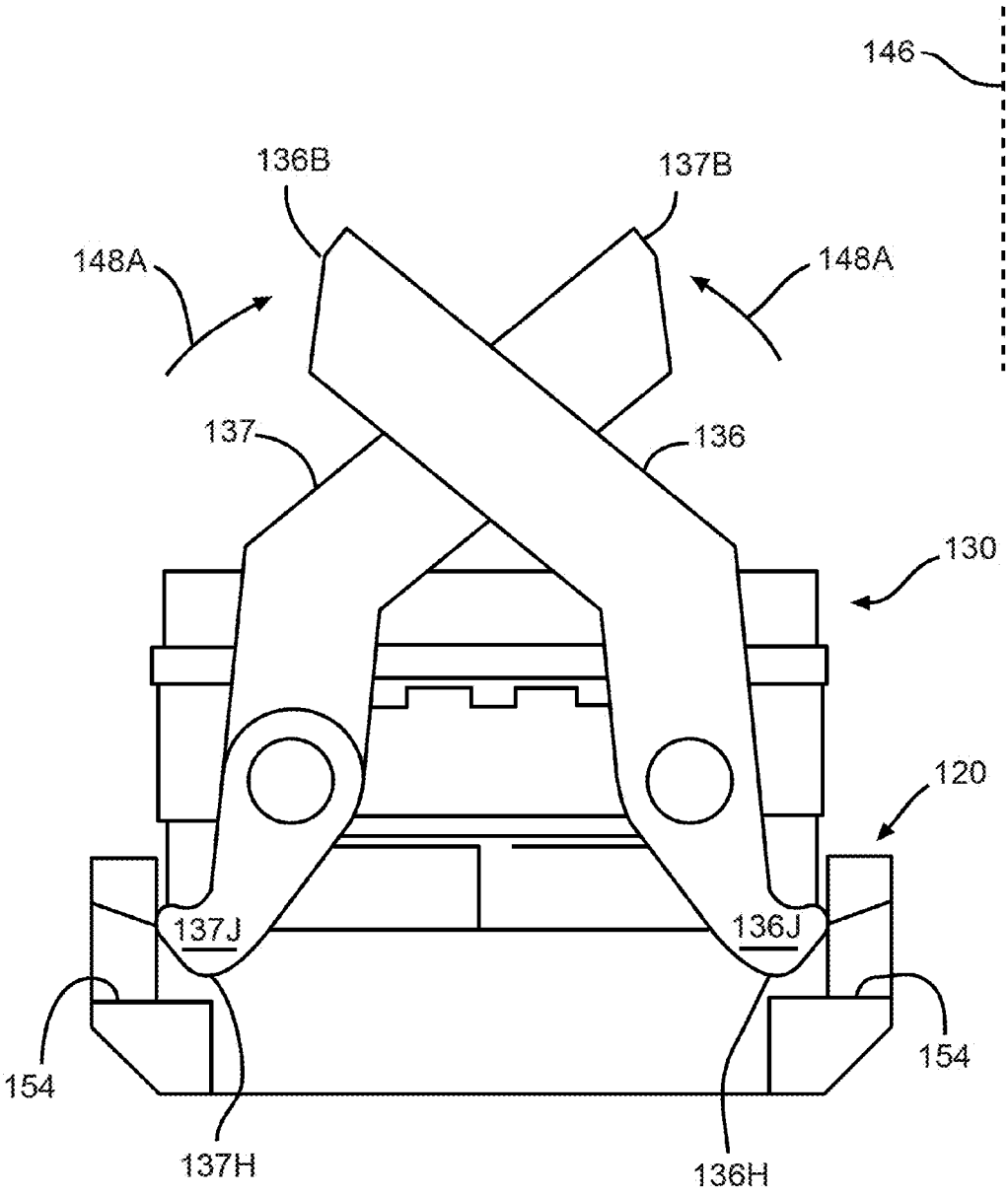

146
136B
137B
148A
148A
137
136
130
120
137J
136J
154
154
137H
136H

FIG. 18

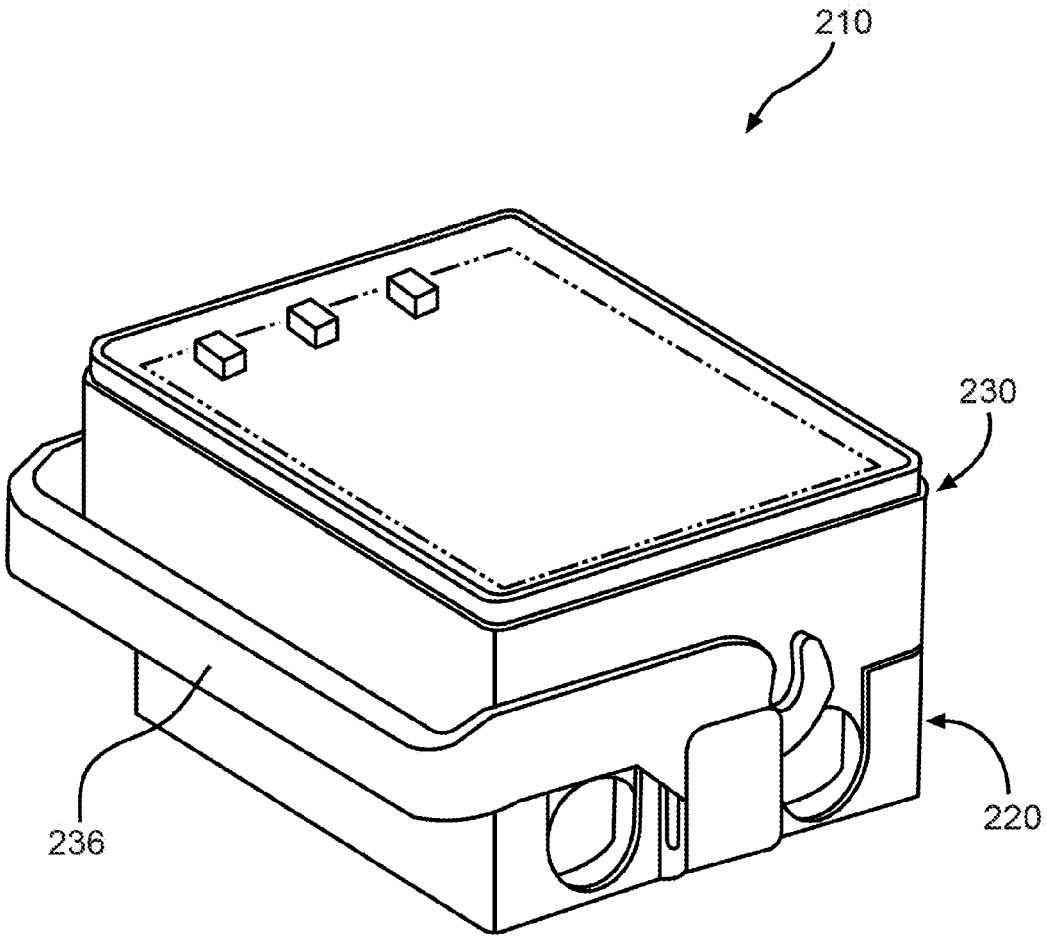


FIG. 19

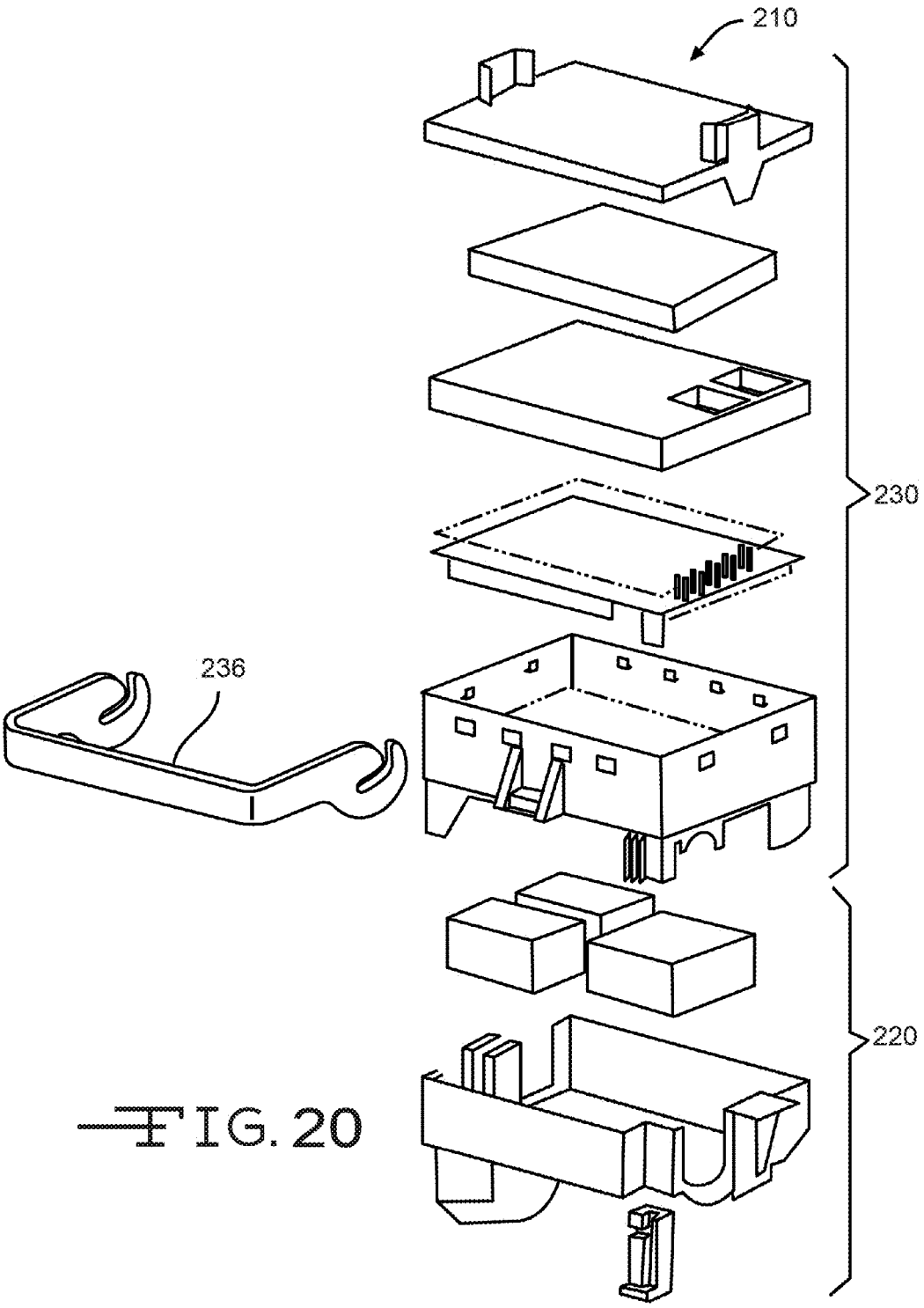


FIG. 20

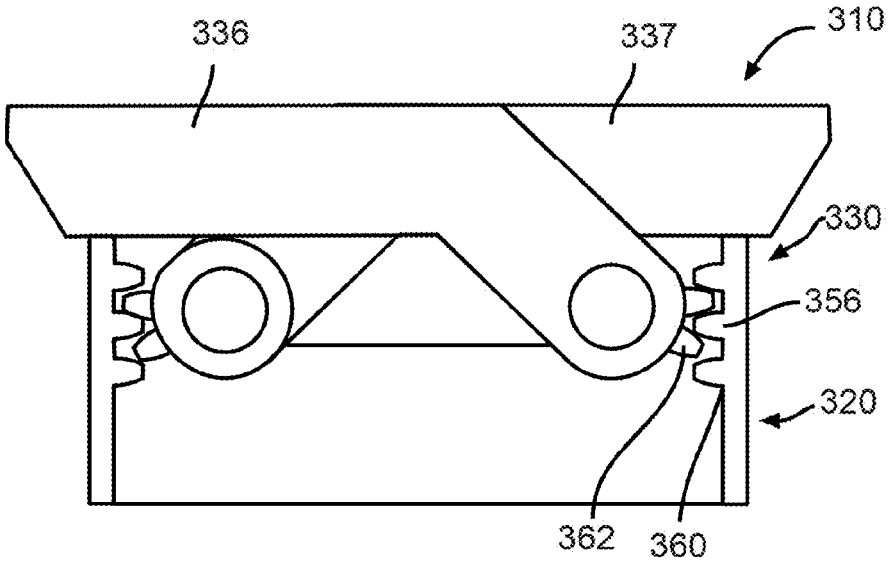


FIG. 21

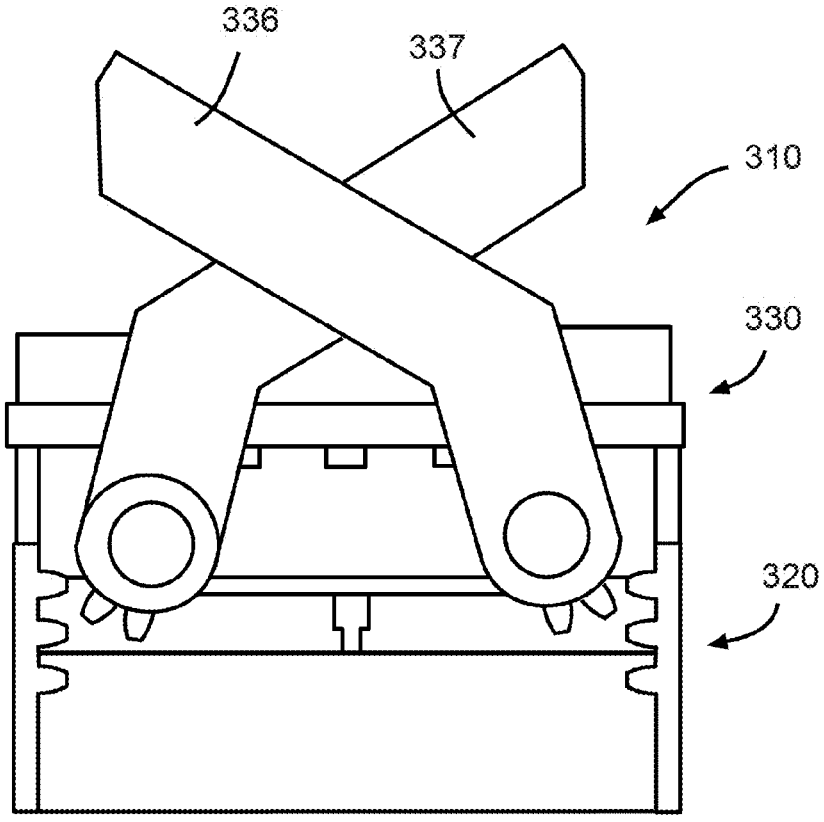


FIG. 22

ELECTRICAL CENTER AND CONNECTOR ASSEMBLY SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/731,544, filed Nov. 30, 2012, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

This invention relates in general to connector assembly systems for electrical junction boxes, such as can be used to connect a plurality of electrical components provided in an automobile. More specifically, this invention relates to an improved structure for a connector assembly system for an electrical junction box as shown in the illustrated embodiments.

Electric vehicles and hybrid electric vehicles typically include a large number of electrical systems, including high-voltage systems such as drive motors. Electrical connections for these electrical systems are typically made in an electrical junction box. The electrical junction box allows multiple electrical connections to be made simultaneously when the electrical junction box is assembled. The electrical junction box also allows these electrical connections to be disconnected simultaneously when the electrical junction box is disassembled. This is advantageous because, for example, it allows all high-voltage systems on the vehicle to be disconnected at one place before maintenance work is done on the vehicle.

Because a large number of electrical connections can be made in the electrical junction box, and because high voltage connections can require large electrical connectors, a large amount of force may be required to assemble and disassemble the electrical junction box. This may also require the use of a specialized tool. It would be advantageous to have an electrical junction box that is easier to assemble.

SUMMARY OF THE INVENTION

This invention relates to an electrical junction box. The electrical junction box has a connector retainer assembly with a first contact surface. The electrical junction box also has a connector housing assembly including a pivotal lever arm, the lever arm having a first engagement surface. The connector retainer assembly and the connector housing assembly are configured so that when the lever arm is moved in a single direction relative to the connector housing assembly, the first engagement surface engages the first contact surface and the connector housing assembly moves relative to the connector retainer assembly from a pre-staged position to an assembled position.

This invention further relates to an electrical junction box with a connector retainer assembly and a connector housing assembly. The connector housing assembly includes a first pivotal lever arm and a second pivotal lever arm. The first lever arm and the second lever arm are arranged in a crossing configuration. The connector retainer assembly and the connector housing assembly are configured so that when the first lever arm and the second lever arm are moved in respective single directions relative to the connector housing assembly, the connector retainer assembly moves relative to the connector retainer assembly from a pre-staged position to an assembled position.

This invention further relates to an electrical junction box having a connector retainer assembly and a connector housing assembly. A first lever arm is pivotally connected to the connector housing assembly and a second lever arm is also pivotally connected to the connector housing assembly. The first lever arm and the second lever arm are arranged in a crossing configuration. A plurality of electrical terminals are mounted on the connector retainer assembly and a circuit board assembly is connected to the connector housing assembly. The connector retainer assembly and the connector housing assembly configured so that when the first lever arm and the second lever arm are moved in respective single directions relative to the connector housing assembly, the connector housing assembly moves relative to the connector retainer assembly from a pre-staged position to an assembled position. When the connector housing assembly is in a pre-staged position relative to the connector retainer assembly the electrical terminals are not mated with the circuit board assembly. When the connector housing assembly is in the assembled position relative to the connector retainer assembly the electrical terminals are mated with the circuit board assembly.

Various aspects of this invention will become apparent to those skilled in the art from the following detailed description of the illustrated embodiments, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an electrical junction box, in accordance with a first illustrated embodiment.

FIG. **2** is an exploded perspective view of the electrical junction box of FIG. **1**.

FIG. **3** is an enlarged perspective view of a base of the electrical junction box shown in FIG. **2**.

FIG. **4** is an exploded perspective view of a connector housing assembly of the electrical junction box shown in FIG. **2**.

FIG. **5** is a perspective view of the connector housing assembly in FIG. **4** partially assembled with a pre-fuse assembly shown in an unassembled position.

FIG. **6** is a perspective view of the connector housing assembly of FIG. **4** with the pre-fuse assembly shown in an assembled position.

FIG. **7** is a perspective view of the connector housing assembly in FIG. **6** with a cover attached to the pre-fuse assembly.

FIG. **8** is a top view of the connector housing assembly in shown in FIG. **7**.

FIG. **9** is a side elevational view of the electrical junction box in FIG. **1** shown in an unassembled position.

FIG. **10** is a side elevational view of the electrical junction box in FIG. **1** shown in a pre-staged position, with the connector base in partial cross-section.

FIG. **11** is a side elevational view of the electrical junction box similar to that shown in FIG. **10**, shown moved away from the pre-staged position and toward an assembled position.

FIG. **12** is a side elevational view of the electrical junction box in FIG. **1** shown in the assembled position.

FIG. **13** is a perspective view of an alternative electrical junction box shown in an unassembled position. The alternative electrical junction box has lever arms with a different configuration from that of the electrical junction box shown in FIG. **1**.

FIG. **14** is a side elevational view of the electrical junction box of FIG. **13** shown in a pre-staged position.

FIG. **15** is a side elevational view of the electrical junction box in FIG. **13** shown in a partially assembled position.

FIG. **16** is a side elevational view of the electrical junction box in FIG. **13** shown in an assembled position.

FIG. **17** is a side elevational view of the electrical junction box in FIG. **13** shown in a partially unassembled position.

FIG. **18** is a side elevational view of the electrical junction box in FIG. **13** shown in a further partially unassembled position.

FIG. **19** is a perspective view of a second alternative electrical junction box shown in an assembled position. The second alternative junction box is similar to the electrical junction box of FIG. **1**, but only has a single lever arm.

FIG. **20** is an exploded perspective view of the electrical junction box of FIG. **19**.

FIG. **21** is a side elevational view of a third alternative electrical junction box shown in an assembled position. The third alternative electrical junction box includes a rack and pinion system to assemble the electrical junction box.

FIG. **22** is a side elevational view of the electrical junction box of FIG. **21** shown in a partially assembled position.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Referring now to the drawings, there is illustrated in FIG. **1** an electrical junction box, indicated generally at **10**, in accordance with a first illustrated embodiment. The illustrated electrical junction box **10** is suitable for use as an under-hood electrical center (UEC) in an automobile or other vehicle. Although the electrical junction box **10** will be described and illustrated in the context of an UEC, it should be appreciated that the electrical junction box **10** can be used in any other desired environment for providing electrical connections.

Referring now to FIG. **2**, an exploded view of the electrical junction box **10** is shown. The illustrated electrical junction box **10** includes a connector retainer assembly, indicated generally at **20** and a connector housing assembly, indicated generally at **30**. The connector retainer assembly **20** includes a base **22** and a wire harness assembly **24**. The connector housing assembly **30** includes a lower housing **32**, a circuit board assembly **33**, an upper housing **34**, a plurality of electrical components **35**, a first lever arm **36**, a second lever arm **37**, a cover **38**, and a pre-fuse assembly **40**. As will be described below, the first lever arm **36** and the second lever arm **37** allow an operator (not shown) to connect the components of the electrical junction box **10** by moving the assembled connector retainer assembly **20** and the assembled connector housing assembly **30** toward each other in an assembly direction indicated by the line **46**.

The base **22** defines a generally open box-like structure having a bottom **22**A and side walls **22**B that extend from the base **22**A to define an exposed base cavity **22**C. The base **22** may have a shape or size different from that illustrated if desired, depending on the arrangement of electric components included in the electrical junction box **10**, for example, as will be described below. The base **22** is made of a blow molded plastic, but may be made of any desired material. The wire harness assembly **24** includes a plurality of wire harnesses **24**A and a plurality of electrical terminals **25**, the purpose of which will be explained below. The wire harness assembly **24** is supported within the inner cavity **22**C of the base **22**. It should be appreciated that the side walls **22**B of the base **22** define apertures to accommodate the wire harnesses **22**A. It should further be appreciated that the arrangement of apertures in the base **22** may differ from that illustrated, in order to accommodate a desired arrangement of wire harnesses.

Referring to FIG. **3**, a perspective view of the base **22** is shown. The base **22** includes a plurality of latch pins **26**. The illustrated base **22** includes two pair of latch pins **26**, with one latch pin of each pair located on opposed side walls **22**B (only one of each pair of latch pins **26** is visible in FIG. **3**). Each pair of latch pins **26** defines a pin axis, **26**A. The latch pins **26** are cylindrical members that extend generally perpendicular from the side walls **22**B of the base **22**. The pairs of latch pins **26** are engaged by the first lever arm **36** and the second lever arm **37** respectively when the connector housing assembly **30** is connected to the connector retainer assembly **20**, as will be described below. The latch pins **26** may have a different shape that is suitable for this purpose, if desired. The illustrated latch pins **26** are molded as part of the base **22**. Alternatively, the latch pins **26** may be separate components that are connected to the base **22**, if desired.

The base **22** further includes a plurality of optional retaining latch members **28**. The retaining latch members **28** are resilient, yet flexible tongues that extend upwardly from the side walls **22**B of the base **22**. The retaining latch members **28** provide retainers for the first level arm **36** and the second lever arm **37** on the assembled electrical junction box **10**, as will be described below. In the illustrated embodiment, a pair of retaining latch members **28** is respectively provided on each of the side walls of the base **22**, for a total of four retaining latch members **28**. The base **22** may, however, include any number or configuration of retaining latch members **28** as desired. As shown in FIG. **3**, the retaining latch members **28** are generally C-shaped tabs that define an aperture that extends therethrough.

Referring now to FIG. **4**, the connector housing assembly **30** is shown. The illustrated lower housing **32** is a generally open box-like structure having a base **32**B and a plurality of side walls **32**C that define an inner cavity **32**D. The base **32**B of the lower housing **32** defines a plurality of apertures that extend there through, in order to accommodate the components of the circuit board assembly **33**. Optional guide posts **32**A are provided at each corner of the lower housing **32**. The illustrated guide posts **32**A extend from the lower housing **32** generally perpendicular to the base **32**B. The guide posts **32**A are received within the corners of the base **22** when the electrical junction box **10** is assembled (as described below) in order to facilitate proper alignment of the connector housing assembly **30** and the connector retainer assembly **20**.

The printed circuit board assembly **33** includes a plurality of printed circuits **33**B. It should be appreciated that the printed circuit board assembly **33** can be tailored for a specific application. Although the illustrated embodiment describes a plurality of printed circuits, it should be appreciated that the printed circuit board assembly **33** and the electrical components **35** may be replaced with any other desired electrical components that are to be connected to the electrical terminals **25**. As will be explained below, an electrically conductive stud **33**A is supported on the printed circuit board assembly **33** and extends there from.

The illustrated upper housing **34** is an open box-like structure that includes a housing surface **34**D and side walls **34**E that extend generally perpendicularly to the housing surface **34**D to define an exposed inner cavity. The upper housing **34** may, however, have any shape or configuration as desired. The upper housing **34** defines two pair of support apertures **34**A on opposed side walls thereof (only one of each pair of support apertures **34**A is visible in FIG. **4**). One pair of support apertures **34**A defines a first support axis **34**F and the second pair of support apertures **34**A defines a second support axis **34**G. Each pair of support apertures **34**A pivotally sup-

ports one of the first lever arm **36** and the second lever arm **37** for rotation relative to the upper housing **34**.

The upper housing **34** includes a plurality of retaining features provided on the housing surface **34**D to support the electrical components **35**. The electrical components **35** can be fuses, relays, or other desired electrical components that engage with the printed circuits **33**B of the circuit board assembly **33**. The illustrated upper housing **34** further includes a plurality of latch members **34**B that extend upwardly from the housing surface **34**D and downwardly from the side walls **34**E. The latch members **34**B serve to provide a snap fit to secure to the upper housing **34** to the lower housing **32** and to the cover **38** when the electrical junction box **10** is assembled. The upper housing **34** may have a different number or configuration of latch members **34**B from that illustrated, if desired.

The cover **38** is secured to the upper housing **34** when the electrical junction box **10** is assembled in order to protect the electrical components **35**. The illustrated cover is made of blow molded plastic, but may be made of any other desired material.

The first lever arm **36** and the second lever arm **37** are substantially similar to one another; therefore, only the first lever arm **36** will be described in detail. Components of the second lever arm **37** that are similar to components of the first lever arm **37** will be labeled with the same letter with the prefix "**37**." The lever arm **36** includes a pair of side arms **36**A that are free at their proximal ends and connected by a handle **36**B at their distal ends. The illustrated proximal ends of each side arm **36**A defines a single cam slot **36**C formed therein. The cam slot **36**C defines a curved path, the purpose of which will be explained below. A pair of pivot pins **36**D is respectively provided on opposing inner surfaces of each side arm **36**A so as to be coaxially aligned with one another (only one of the pivot pins **36**D is visible in FIG. **4**). The pivot pins **36**D are located near the inner surface of the curved cam slots **36**C, respectively. The lever arm **36** includes a pair of locking protrusions **36**E that is respectively provided on outer surfaces of the side arms **36**A. The locking protrusions **36**E engage the latch members **28** on the base **22** (shown in FIG. **3**) when the electrical junction box **10** is assembled in order to retain the first lever arm **36** in position. It should be appreciated that the first lever arm **36** and the second lever arm **37** are not limited to the illustrated embodiment, but may have any desired shape or configuration as desired.

Referring now to FIGS. **2** through **4**, assembly of the connector housing assembly **30** will be described. As best seen in reference to FIG. **4**, the electrical conductive stud **33**A is connected to the printed circuit board assembly **33** and the printed circuit board assembly **33** is placed into inner cavity **32**D of the lower housing **32**. The upper housing **34** is connected to the lower housing **32** and snap-fit thereto by the lower latch members **34**B. As such, the printed circuit board assembly **33** is enclosed by lower housing **32** and the upper housing **34**. The electrical components **35** are connected to the housing surface **34**D of the upper housing **34** and are placed into contact with the printed circuit board assembly **33** through the housing surface **34**D of the upper housing **34**.

The first lever arm **36** and the second lever arm **37** are pivotally connected to the upper housing **34**. The pair of pivot pins **36**D on the first lever arm **36** are inserted into a pair of support apertures **34**A so that the pivot pins **36**D are located on the first support axis **34**F. Similarly, the pair of pivot pins **37**D on the second lever arm **37** are inserted into the other pair of support apertures **34**A so that the pivot pins **37**D are located on the second support axis **34**G. As best seen in FIGS. **6** through **8**, the first lever arm **36** and the second lever arm **37** are arranged in a crossing configuration. That is, in a direction that is perpendicular to the assembly direction **46** and perpendicular to the first support axis **34**F, the second support axis **34**G is located between the first support axis **34**F and the handle **36**B of the first lever arm **36**. Similarly, the first support axis **34**F is located between the second support axis **34**G and the handle **37**B of the second lever arm **37**. It should be appreciated that this configuration provides an increased length of the first lever arm **36** and the second lever arm **37** as compared to a non-crossed lever arm configuration.

The cover **38** is connected to the upper housing **34** to enclose the electrical components **35**. The cover **38** can be secured to the upper housing **34** by the upper latch members **34**B.

As best shown in FIG. **5** through **8**, the pre-fuse assembly **40** is connected to the connector housing assembly **30**. The pre-fuse assembly **40** defines a pair of slots **42** on opposite sides thereof that receive latch tabs **34**C that extend from the upper housing **34**. This allows a snap-fit connection between the upper housing **34** and the pre-fuse assembly **40**. It should be appreciated that the pre-fuse assembly **40** may be attached to the upper housing **34** using some other suitable connector, if desired. As shown in FIGS. **7** and **8**, an optional pre-fuse cover **44** may be secured over the pre-fuse assembly **40**. In this position, the connector housing assembly **30** may be packaged as a unit if desired.

Referring now to FIGS. **9** through **12**, the operation of the first lever arm **36** and the second lever arm **37** will be described. As shown in FIG. **9**, the connector retainer assembly **20** has been assembled, and the connector housing assembly **30** has been assembled. The first lever arm **36** and the second lever arm **37** are in respective raised positions. The connector housing assembly **30** is positioned above the connector retainer assembly **20** and is moved in the assembly direction **46** into contact with the connector retainer assembly **20**. The guide posts **32**A on the lower housing **32** are received within corners of the base **22**. This facilities proper alignment of the connector housing assembly **30** relative to the connector retainer assembly **20**.

Referring now to FIG. **10**, the connector housing assembly **30** is shown in a pre-staged position. The side wall **22**B of the base **22** is not shown in FIGS. **10** and **11** so that the engagement of the first lever arm **36** with the latch pin **26** is visible. A proximal end **36**F of the first lever arm **36** is in contact with a latch pin **26** of the base **22**. It should be appreciated that the other side arm of the first lever arm **36** (which is not visible in FIG. **10**) is in contact with the opposed latch pin **26**. With the connector housing assembly **30** in the pre-staged position, the operator can move the handle **36**B of the first lever arm **36** and handle **37**B of the second lever arm **37** generally away from each other. This causes the first lever arm **36** and the second lever arm **37** to rotate about the first support axis **34**F and the second support axis **34**G respectively, relative to the connector housing assembly **30**. This motion is indicated by the arrows **48** in FIG. **11**.

The first lever arm **36** includes an engagement surface **36**G adjacent the cam slot **36**C. As the first lever arm **36** is rotated away from the raised position, the engagement surface **36**G engages a contact surface **52** of the latch pin **26** and guides the latch pin **26** into the cam slot **36**C, as shown in FIG. **11**. Because the first lever arm **36** is attached to the upper housing **34** at the support aperture **34**A, and the latch pin **26** is engaged with the cam slot **36**C, further movement of the first lever arm **36** in the direction indicated by arrow **48** causes the upper housing **34** and the lower housing **32** to be drawn together in the assembly direction **46**. This allows the upper housing **34** and the lower housing **32** to be drawn into mating engagement

from the pre-staged position by pivoting the first lever arm **36** in a single motion in a single direction **48**. It should be appreciated that the second lever arm **37** can be rotated at the same time as the first lever arm **36** in order to increase the force drawing the upper housing **34** and the lower housing **32** together, and to distribute the force across the electrical junction box **10**.

Referring now to FIG. **12**, the electrical junction box **10** is shown when the connector housing assembly **30** is in an assembled position. The connector housing assembly **30** is engaged with the connector retainer assembly **20**, and the first lever arm **36** and the second lever arm **37** are in their respective lowered positions. When the connector housing assembly **30** is in the assembled position, the electrical terminals **25** (best seen in FIG. **2**) are mated with the circuit board assembly **33** and electrical connections are established between the wire harness assembly **24** and the electrical components **35**. It should be appreciated that the first lever arm **36** is retained in the lowered position by the engagement of the locking protrusion **36**E with the latch member **28** on the base **22**.

The first lever arm **36** and the second lever arm **37** may be moved from the lowered positions shown in FIG. **12** to the raised positions shown in FIG. **10**. A second contact surface **54** (best seen in FIG. **11**) of the latch pin **26** will engage a removal surface **36**H of the cam slot **36**C, causing the connector housing assembly **30** and the connector retainer assembly **20** to be pushed apart in the assembly direction **46** until the connector housing assembly **30** is in the pre-staged position shown in FIG. **10**. When the connector housing assembly **30** is in the pre-staged position, the electrical terminals **25** are not mated with the circuit board assembly **33** and electrical connections are not established between the wire harness assembly **24** and the electrical components **35**. It should be appreciated that this is accomplished by moving the first lever arm **36** in a single motion in a second single direction opposite the direction **48**. However, it should be appreciated that when the connector housing assembly **30** is in the pre-stage position, some components of the circuit board assembly **33** may still be in physical contact with the wire harness assembly **24**. Once in the pre-staged position, the connector housing assembly **30** may be lifted away from the connector retainer assembly **20**.

Referring now to FIG. **13**, an alternative electrical junction box, indicated generally at **110**, in accordance with a second embodiment is shown. The alternative electrical junction box **110** may include any structural features as described and illustrated above in the previous embodiments, although such is not required. Similar features have been numbered with common reference numerals but have been increased by 100 (e.g. **120**, **130**, **140**, etc.). It should be appreciated that similar features are structured similarly, operate similarly, and/or have the same function unless otherwise indicated by the drawings or this specification.

The alternative electrical junction box **110** includes a connector retainer assembly **120** and a connector housing assembly **130**. The connector retainer assembly **120** includes a plurality of latch posts **150**, one at each corner of the connector retainer assembly **120**. Each latch post **150** defines an upper contact surface **152** and a lower contact surface **154**, the purpose of which will be explained below. As shown, the upper contact surface **152** is angled relative to the lower contact surface **154**, although the contact surfaces **152** and **154** can be configured in any manner.

The illustrated connector housing assembly **130** includes a first lever arm **136** and a second lever arm **137**. The first lever arm **136** and the second lever arm **137** are pivotally connected to the connector housing assembly **130** in a crossing configuration, as described above in the first embodiment. The distal ends of the first lever arm **136** and the second lever arm **137** respectively define hook portions **136**J and **137**J. It should be appreciated that the hook portions **136**J and **137**J can be shaped and otherwise configured different from the particular illustrated embodiment, if desired.

Referring now to FIGS. **14** through **18**, the operation of the first lever arm **136** and the second lever arm **137** will be described. As shown in FIG. **14**, the connector retainer assembly **120** has been assembled, and the connector housing assembly **130** has been assembled. The first lever arm **136** and the second lever arm **137** are in respective raised positions. The connector housing assembly **130** is positioned above the connector retainer assembly **120** and is moved in an assembly direction **146** into contact with the connector retainer assembly **120**. Guide posts **132**A (shown on FIG. **13**) on the lower housing **132** are received within corners of the base **122**. This facilities proper alignment of the connector housing assembly **130** relative to the connector retainer assembly **120**. The connector housing assembly **130** is moved toward the connector retainer assembly **120** until a proximal end **136**F of the hook portion **136**J is in contact with the lower contact surface **154**. The connector housing assembly **130** is then in a pre-staged position.

Referring now to FIG. **15**, the operator can move a handle **136**B of the first lever arm **136** and a handle **137**B of the second lever arm **137** generally away from each other. This causes the first lever arm **136** and the second lever arm **137** to rotate relative to the connector housing assembly **130**. This motion is indicated by the arrows **148**. Rotation of the first lever arm **136** causes an engagement surface **136**G of the hook portion **136**J to engage the upper contact surface **152**. This causes the upper housing **134** and the lower housing **132** to be drawn into mating engagement. This allows the upper housing **134** and the lower housing **132** to be drawn into mating engagement from the pre-staged position by pivoting the first lever arm **136** in a single motion in a single direction **148**.

Referring now to FIG. **16**, the connector housing assembly **130** is in an assembled position. The connector housing assembly **130** is engaged with the connector retainer assembly **120** and the first lever arm **136** and the second lever arm **137** are in their respective lowered positions.

As shown in FIGS. **17** and **18**, the connector housing assembly **130** can be disassembled from the connector retainer assembly **120** by moving the first lever arm **136** and the second lever arm **137** in a second direction **148**A generally toward each other. It should be appreciated that the second direction **148**A is opposite the direction **148**. When the first lever arm **136** is moved in this direction, a removal surface **136**H of the hook portion **136**J engages the lower contact surface **154**. This applies a force that pushes the connector housing assembly **130** and the connector retainer assembly **120** apart in the assembly direction **146**, until the connector housing assembly **130** is in the pre-staged position. At this point, the connector housing assembly **130** is no longer engaged with the connector retainer assembly **120**, and may be removed.

Referring now to FIGS. **19** and **20**, there is illustrated an second alternative electrical junction box, indicated generally at **210**, in accordance with a third illustrated embodiment. The second alternative electrical junction box **210** may include any structural features as described and illustrated above in the previous embodiments, although such is not required. Similar features have been numbered with common reference numerals but have been increased by 200 (e.g. **220**, **230**, **240**, etc.). It should be appreciated that similar features are struc-

tured similarly, operate similarly, and/or have the same function unless otherwise indicated by the drawings or this specification.

As shown in FIG. **20**, the second alternative electrical junction box **210** includes a connector retainer assembly **220** and a connector housing assembly **230**. The connector housing assembly **230** includes a single lever arm **236**, as opposed to a pair of lever arms seen in the previous embodiments. The single lever arm **236** is, in large measure, similar to the first lever arm **36** described above in the first illustrated embodiment. Therefore, a detailed description will not be provided. The operation of the second alternative electrical junction box **210** is also similar to the electrical junction box **10**, with the exception that only a single lever arm **236** is provided.

Referring now to FIGS. **21** and **22**, there is illustrated a third alternative electrical junction box, indicated generally at **310**, in accordance with a fourth illustrated embodiment. The third alternative electrical junction box **310** may include any structural features as described and illustrated above in the previous embodiments, although such is not required. Similar features have been numbered with common reference numerals but have been increased by 300 (e.g. **320**, **330**, **340**, etc.). It should be appreciated that similar features are structured similarly, operate similarly, and/or have the same function unless otherwise indicated by the drawings or this specification.

The illustrated third alternative electrical junction box **310** includes a connector retainer assembly **320** and a connector housing assembly **330**. The connector housing assembly **330** further includes a first lever arm **336** and a second lever arm **337**. The first lever arm **336** and the second lever arm **337** are supported for pivotal movement on the connector housing assembly **330** in a crossing configuration, as previously described. The third alternative electrical junction box **310** includes a rack and pinion gear system **356** for engaging and disengaging the connector housing assembly **330** and the connector retainer assembly **320**. The connector retainer assembly **320** includes a gear rack **360** that extends along a side wall thereof. The proximal end of the first lever arm **336** includes pinion gears **362**, respectively. In operation, when the first lever arm **336** and the second lever arm **337** are pivoted from a raised position (as shown in FIG. **22**) to a lowered position (as shown in FIG. **21**), the pinion gears **362** mesh with the gear racks **360** to draw the connector housing assembly **330** into mating engagement with the connector retainer assembly **320**. It should be appreciated that the gear racks **360** and the pinion gears **362** may be configured in any desired manner to accomplish the desired functions.

The principle and mode of operation of this invention have been explained and illustrated in the embodiments. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.

What is claimed is:

1. An electrical junction box comprising:

a connector retainer assembly having a latch pin extending outward therefrom, the latch pin defining a contact surface; and

a connector housing assembly including a pivotal lever arm having a first end and a second end pivotally attached to the connector housing assembly, the second end of the lever arm having a cam slot formed therein, the cam slot defining an engagement surface;

wherein the connector retainer assembly and the connector housing assembly are configured so that when the lever arm is moved in a single motion in a single direction relative to the connector housing assembly, the engagement surface engages the contact surface and moves the connector housing assembly from a pre-staged position relative to the connector retainer assembly to an assembled position relative to the connector retainer assembly;

wherein in the pre-staged position the lever arm and the latch pin are positioned such that the latch pin is outside of the cam slot and spaced apart from the engagement surface, and wherein in the assembled position the lever arm and the latch pin are positioned such that the latch pin is within the cam slot.

2. The electrical junction box of claim **1**, further comprising: a plurality of electrical terminals mounted on the connector retainer assembly, and a circuit board assembly connected to the connector housing assembly;

wherein when the connector housing assembly is in the pre-staged position relative to the connector retainer assembly, the electrical terminals are not mated with the circuit board assembly, and when the connector housing assembly is in the assembled position relative to the connector retainer assembly, the electrical terminals are mated with the circuit board assembly.

3. The electrical junction box of claim **2**, wherein the lever arm is a first lever arm, the connector housing assembly includes a pivotally connected second lever arm, and the first lever arm and the second lever arm are arranged in a crossing configuration.

4. The electrical junction box of claim **1**, wherein the lever arm further has a removal surface, and wherein the connector retainer assembly and the connector housing assembly are further configured so that when the lever arm is moved in a single second direction relative to the connector housing assembly, the removal surface engages the contact surface and moves the connector housing assembly from the assembled position relative to the connector retainer assembly to the pre-staged position relative to the connector retainer assembly.

5. The electrical junction box of claim **4**, further comprising:

a plurality of electrical terminals mounted on the connector retainer assembly; and

a circuit board assembly connected to the connector housing assembly;

wherein when the connector housing assembly is in the pre-staged position relative to the connector retainer assembly, the electrical terminals are not mated with the circuit board assembly and, when the connector housing assembly is in the assembled position relative to the connector retainer assembly, the electrical terminals are mated with the circuit board assembly.

6. The electrical junction box of claim **1**, wherein the lever arm is a first lever arm and the connector housing assembly includes a pivotally connected second lever arm, wherein the first lever arm and the second lever arm are arranged in a crossing configuration.

7. The electrical junction box of claim **5**, wherein one of the lever arm and the connector retainer assembly includes a gear rack, and the other of the lever arm and the connector retainer assembly includes pinion gears, and wherein the pinion gears and gear rack mesh and move relative to each other when the lever arm is pivoted relative to the connector housing assembly.

8. The electrical junction box of claim **7**, wherein the lever arm is a first lever arm and the connector housing assembly includes a pivotally connected second lever arm, and wherein the first lever arm and the second lever arm are arranged in a crossing configuration.

9. An electrical junction box comprising:
a connector retainer assembly; and
a connector housing assembly including a first pivotal lever arm pivotally attached to the connector housing assembly about a first pivot axis and a second pivotal lever arm pivotally attached to the connector housing assembly about a second pivot axis spaced apart from the first pivot axis, wherein the first lever arm and the second lever arm are arranged in a crossing configuration;
wherein the connector retainer assembly and the connector housing assembly are configured so that when the first lever arm and the second lever arm are each moved in respective single motions about their respective pivot axes in respective single directions relative to the connector housing assembly, the connector retainer assembly moves from a pre-staged position relative to the connector retainer assembly to an assembled position relative to the connector retainer assembly.

10. The electrical junction box of claim 9, further comprising: a plurality of electrical terminals mounted on the connector retainer assembly, and a circuit board assembly connected to the connector housing assembly;
wherein when the connector housing assembly is in the pre-staged position relative to the connector retainer assembly, the electrical terminals are not mated with the circuit board assembly, and when the connector housing assembly is in the assembled position relative to the connector retainer assembly, the electrical terminals are mated with the circuit board assembly.

11. An electrical junction box comprising:
a connector retainer assembly;
a connector housing assembly;
a first lever arm pivotally connected to the connector housing assembly about a first pivot axis;
a second lever arm pivotally connected to the connector housing assembly about a second pivot axis spaced apart from the first pivot axis, wherein the first lever arm and the second lever arm are arranged in a crossing configuration;
a plurality of electrical terminals mounted on the connector retainer assembly; and
a circuit board assembly connected to the connector housing assembly; wherein
the connector retainer assembly and the connector housing assembly configured so that when the first lever arm and the second lever arm are each moved in respective single motions in respective single directions relative to the connector housing assembly, the connector housing assembly moves from a pre-staged position relative to the connector retainer assembly to an assembled position relative to the connector retainer assembly;
when the connector housing assembly is in the pre-staged position relative to the connector retainer assembly, the electrical terminals are not mated with the circuit board assembly; and
when the connector housing assembly is in the assembled position relative to the connector retainer assembly, the electrical terminals are mated with the circuit board assembly.

* * * * *